Design of a modular workbench unit with storage for a learning factory.

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An assembly line for Industrial Design Engineering students is added to an upcoming Learning Factory at the University of Twente. The first years students will be assembling designs made by the second years. This teaches second year students to think about how their designs impact the people at the assembly line. It also gives first years the opportunity to practically learn about assembling. The lay-out of the space may need to be changed multiple times a day to create the most optimal lay-out. To facilitate this activity, a design of a modular workbench unit with storage space for the assembly line is requested. The goal of this project was to design a final 3D model for this workbench.

Preliminary research on assembly lines and workbenches on the market showed that a custom design was needed that was aimed at facilitating assembly lines at a learning factory, is mobile and is modular. Furthermore, it should have a customized appearance for the learning factory, be ergonomic and have storage space. During this project, the Learning Factory was not fully developed. For example, the available space and interior design were undefined, so to account for changes, and to avoid rigidity over time the solution should be as flexible as possible. With this information, functions and requirements were set up. Solutions for these requirements were put into a morphological chart, which served as a base for the design phase.

Ideation resulted in two concept directions. At this stage, the use of air casters as a form of transportation rather than traditional wheels was researched. Then, the most suitable concepts were picked, mainly based on functional qualities. These were conceptualized, and after considering configuration opportunities, two final concepts were selected. Firstly, a modern looking workbench with a flexible back panel, which supports different kinds of inserts, such as whiteboards or peg boards. It has drawers and space for two students, see figure 1.

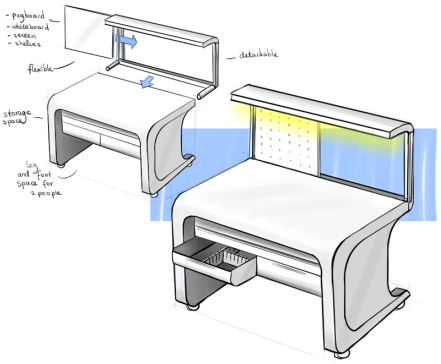

Figure 1 Modern looking concept.

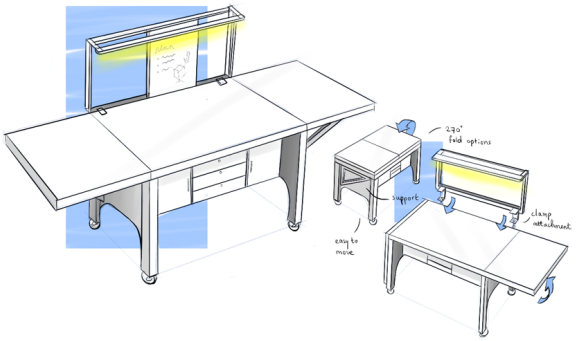

Figure 2 Traditional concept with fold-out.

Secondly, a traditional design with extendable sides and a similar back panel concept, see figure 2. Both concepts were combined with air casters to assess whether this would be a realistic option. The redesign turned out to complement the modern and round visuals of the first concept, after which the application of air casters was seriously considered. An evaluation on transportation methods showed that air casters were the most suitable option.

Thus, the first concept was worked out further, see figure 3. The height was made adjustable, and an embodiment design was created, followed by an interview session with staff members from University of Twente workshops. The results included that the back panel, when reaching 1 meter above the worktop, can block the overview of supervisors. Therefore the back panel was redesigned to be adjustable in height and detachable. Furthermore, it was pointed out that when using air casters, it is convenient to store as much as possible in and on the workbench, because it takes such low effort to move it around. To facilitate this, the storage space was maximized, leaving just enough space for the students to place their legs and feet comfortably.

Figure 3 From concept, to embodiment design, to revised concept.

After implementing the feedback, the design was finalized as shown in figure 4. The details and style were aimed to compliment the workbench modern, curvy and sleek look. During the styling process, it was found that blue rounded accents combined with white surfaces were most suitable. To add some colour, an RGB strip was added, lighting up the storage area. The final design has a wooden worktop, sheet metal body and storage space. It contains power outlets hidden under the work surface as well as on the back. The back panel contains an overhead light and can be detached and extended from a height of 500mm to 1000mm. An air hose adapter hidden under the worktop is easily accessible and makes it possible to connect the air casters to the compressed air supply in few steps. Furthermore, a cross bar between the legs is seamlessly built-in for extra stability. The legs themselves contain a spindle lifting system which carries more than 400 kilograms. Figure 5 shows a final 3D model which visualizes the back and the flexibility of the workbench.

Figure 4 Final concept.

Figure 5 Workbench configurations.

Although the final design fits the flexibility and usability requirements, further research and testing is required, for example on the strength of the worktop, legs and bottom plate, and the

stability and strength of the back panel in order to make the final material choice and find the most suitable thickness. Furthermore, production methods should be considered in order to fully develop the workbench. Lastly, developments of the Cube may require redesigns of the solution, which should be monitored. All in all, the project succeeded at creating a 3D model suitable to be implemented to the Learning Factory, however it requires further assessment to be fully finalized.